

Mentor Marsh Watershed Impairments and Problems

Summary

“This area contains a number of unique ecosystems. Mentor Marsh State Nature Preserve, previously identified as a National Natural Landmark, is currently undergoing hydrologic changes and degradation from water quality impairment and the introduction of exotic species. The area also boasts the last remaining large undeveloped beach on Ohio’s Lake Erie shoreline that supports a diverse ecological community and that serves a valuable natural protective function in an area subject to erosion.” (Davey Resources, 2001)

The Mentor Marsh watershed is located within the Ohio Lake Basin and therefore must apply management measures specific to the Ohio Coastal Nonpoint Pollution Control Program that satisfy Appendix 8 of “A Guide to Developing Local Watershed Action Plans in Ohio”. The following problem statements and restoration goals that satisfy Appendix 8 Management Measures of the Ohio Coastal Nonpoint Pollution Control Program will be numbered accordingly. Many of these measures are not applicable to this watershed action plan.

Non-Applicable Appendix 8 Management Measures of the Ohio Coastal Nonpoint Pollution Control Program

Agriculture (3.3.7) Irrigation Water Management – Exempt with Farm Bureau participation. Only incidental amounts of land use devoted to silviculture in watershed.

Urban (5.3.1) New Development – Exempt with NPDES Phase II participation.

Urban (5.5.1) Existing Development - Exempt with NPDES Phase II participation.

Urban (6.6.2) Operating On-site Disposal Systems – Exempt <1 HSTS per 20 acres

Urban (5.8.5) Road, Highway, and Bridge Operation and Maintenance - Exempt with NPDES Phase II participation.

Urban (5.8.6) Road, Highway, and Bridge Runoff Systems - Exempt with NPDES Phase II participation.

Problem Statement

The problems, or issues, affecting the Mentor Marsh Watershed are best described in the Issues Characterization document that was created for the MARC by Davey Resources in 2001:

“Over the past several months, Task Forces have worked to describe the problems in the Marsh Area SAMP region. The ODNR Division of Real Estate and Land Management, and Dee Hammel with the Ohio Department of Natural Resources’ Division of Natural Areas and Preserves facilitated a process through which the MARC identified and ranked a list of 27 strategic issues to be addressed in the SAMP. These issues were then divided among task forces, which were formed to describe and characterize the issues. These issue characterizations provide the information necessary to begin the strategy development process. Five main issues are characterized by their respective task forces in this document:

- Water Quality

- Land Use and Economic Development
- Wetlands and Biodiversity
- Recreation and Public Access
- Shoreline Management and Nearshore Issues

These five issues were identified as the most critical issues of concern in the region. It is important to stress that this document is dynamic and subject to comments and changes.

Before implementation plans could be addressed, specific items were identified in each of the five main issues. The MARC identified sub-issues within each main issue and assigned a priority status of high, medium, or low. The high and medium priorities were decided to be time sensitive and/or were not currently being addressed by an existing program. Low priority issues were typically covered by existing programs or were otherwise chosen as lower priorities by the stakeholders.

The following is a thorough description of each issue from the “Issue Characterizations Marsh Area SAMP”. (Davey Resources, 2001)

Water Quality

Water quality is a concern throughout the Marsh Area SAMP region. A thorough review of the causes of degraded water quality includes both point and nonpoint pollution sources. Water quality issues are inherently challenging due to the cumulative nature of water quality impacts from watershed activities and the often latent nature of the problems. Planning focus must be toward the impacts of erosion and sedimentation and the loss of habitat upon water quality in order to implement strategies through which long-term protection of the resources can be ensured.

Point Source Pollution

Waste Water Treatment Systems – Low Priority / Urban (5.6.1) and (5.6.2)

These types of sources are controlled primarily through state-run regulatory programs administered by the EPA under the Clean Water Act. Although point sources are regulated, point source pollution from industrial stormwater discharge, industrial sanitary discharge, wastewater treatment plant discharge, and sanitary sewer inflow infiltration may be adversely affecting water quality in the Marsh Area SAMP region.

The wastewater treatment plant located in the watershed is the Greater Mentor Wastewater Treatment Plant. This facility treats 20 million-gallons per day of activated sludge and discharges into Lake Erie immediately east of the mouth of Mentor Harbor. Recently upgraded in July of 2000, the plant has been operating in 100% compliance with their National Pollution Elimination Discharge System (NPDES) permit.

Prior to the plant upgrade and the elimination of Uniroyal Chemical Company, an inhibiting industrial wastewater source, the facility experienced difficulty in achieving consistent discharge compliance. Uniroyal and the Lake County Department of Utilities engaged in a public dispute over the inhibition of the facility's operation during the 1990's. The controversy ended in August 1999 when Uniroyal closed its doors and moved its operations to Mexico. Within two weeks of the industry's closure, the plant recovered and began meeting discharge standards.

Oil and Brine Storage Lagoons and Wells – Low Priority / Urban (5.3.2)

Some concentration of salts and minerals is necessary for the survival, growth, and reproduction of all living organisms. Northeast Ohio and all of the coastal areas along Lake Erie are freshwater ecosystems with typically minimal concentrations of salts and dissolved minerals. Plants and animals throughout Ohio have adapted to life in these freshwater, low mineral environments. Under these conditions, organisms have developed methods to acquire and utilize salts and minerals. Plants use the concentration of salts and dissolved minerals within their tissues to assist in the uptake of water.

Accidental spills from oil and brine wells can introduce large concentrations of salts and minerals into the environment, which in turn can eliminate most, or all, of the native vegetation within a given area. Such sudden and dramatic increases in the concentrations of salts and dissolved minerals can have damaging and dramatic effects. Most of our native flora and fauna cannot tolerate high levels of salts in their environments. A few species of plants are able to adapt to high levels of salts and dissolved minerals. Common reed (*Phragmites australis*) is well adapted to saline environments. This provides an opportunity for monocultures of salt-tolerant species like common reed. Once established, this species can prevent the return of a healthy and diverse ecosystem.

Wetlands are particularly sensitive to the introduction of salts and minerals. Because most wetland environments are depositional, water does not flush through these systems and salts tend to remain for decades. This further hinders the return of a diverse native ecosystem of plants and animals. This contributes to the present poor water quality at Mentor Marsh.

Brine, a salty byproduct of drilling gas and oil wells, is generally disposed of through injection into wells and pockets about a half-mile underground, below drinking water level. Before the brine is injected it is often stored in a holding pond or lagoon. Improperly designed or illegally constructed oil and brine storage lagoons threaten to degrade water quality at ecologically sensitive areas in the watershed. These lagoons can often be attractive nuisances to waterfowl and other wildlife when not properly managed.

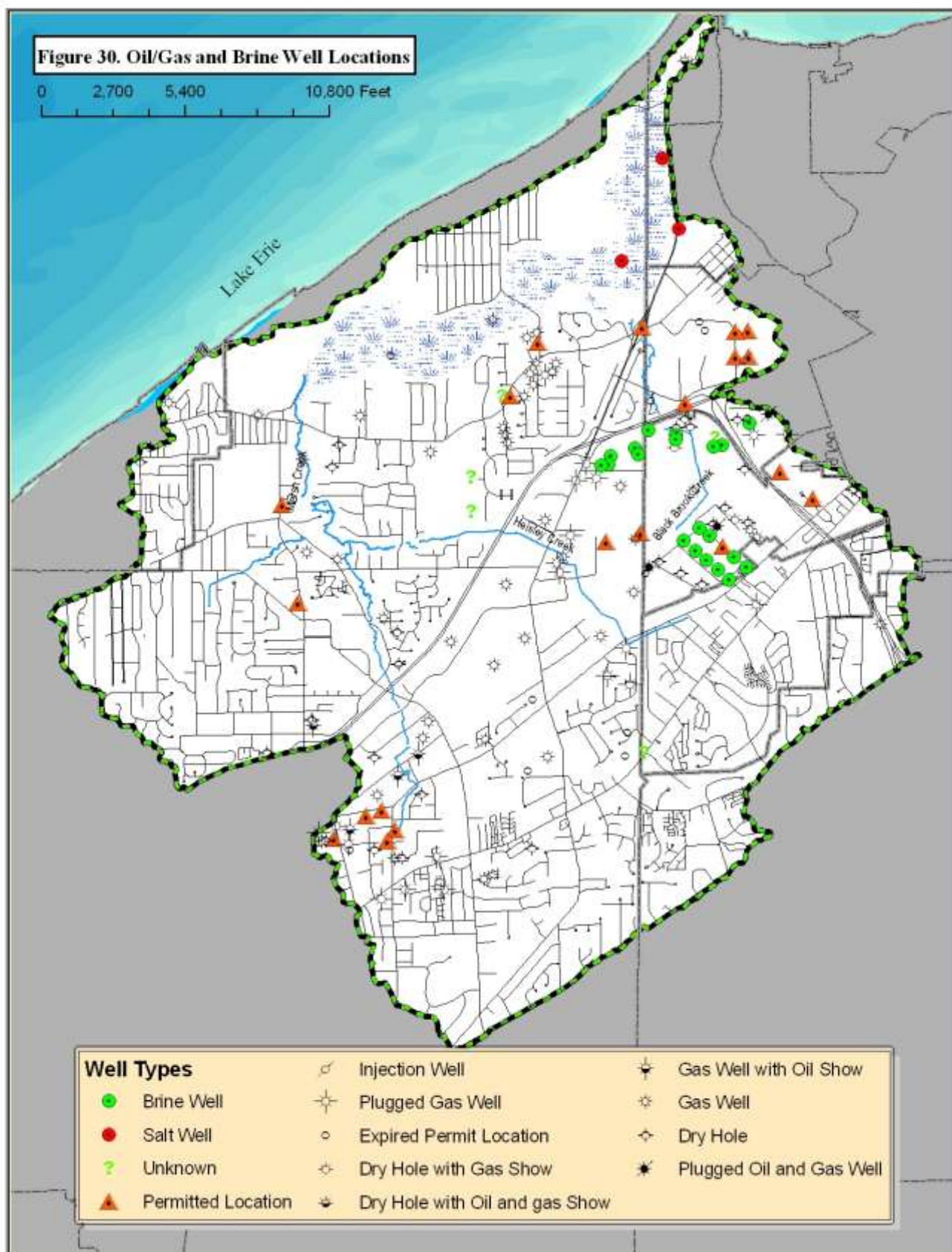
Most, but not all, of the wells have been abandoned and sealed. Historically, high concentrations of dissolved solids and chlorides have entered Mentor Marsh via Black Brook, mainly from Diamond Shamrock's salt brine wells

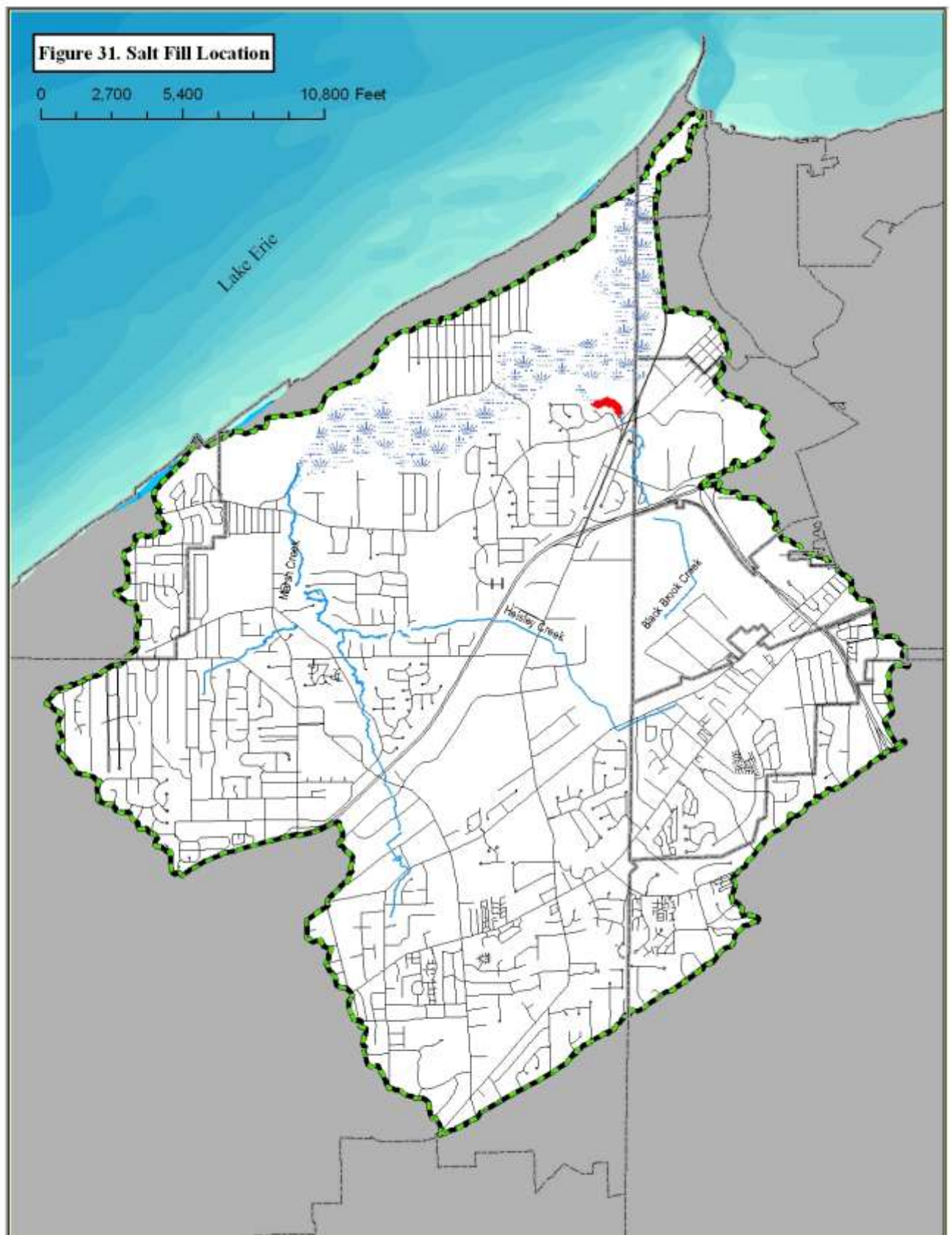
and a waste salt disposal site owned by Jerome Osborne. In 1991, an abandoned brine pit covered with thick oil resulted in the deaths of 59 Canada geese and a Mallard duck. By 1996, the number had increased to over 100 deaths of birds and waterfowl, including a Blue Heron. The deaths were directly attributed to the oil and brine in the storage lagoon. This lagoon also had an oil spill in 1995 that migrated to a nearby creek. On June 18 and 26, 1996, spills totaling approximately 50,000 gallons of oil and brine were reported. The spills made their way to a tributary of the Mentor Marsh. The lagoon was observed to have 1,000,000 gallons of an oily water mixture in the 12,000,000-gallon impoundment.

At the site of the impoundment are also above ground storage tanks. The lagoon and above-ground tanks were reported by the U.S. EPA to present a substantial threat of discharge of oil into or upon the navigable water of the United States. U.S.EPA, U.S. Coast Guard, Ohio EPA, Lake County Health District, Painesville Township Fire Dept., Ohio Department of Natural Resources and others have been involved in the remediation activities and closure activities at this site. When the clean up was complete, 70,000 gallons of crude oil from leaky tanks, 2,000,000 gallons of contaminated water and 30,000 gallons of sludge from the lagoon were removed at a cost of \$1.5 million to the U.S.EPA.

A related concern is the potential of an underground release once the brine is injected to the wells. The leak could migrate through cracks and fissures deep in the earth looking for an outlet. Due to its proximity to numerous underground gas and oil wells now containing brine, the Mentor Marsh would receive any releases from these facilities.

Figure 30 shows the location of the oil and gas wells in the watershed. Figure 31 shows the location of the salt landfill along the mouth of Blackbrook Creek





Salt Contamination – High Priority / Urban (5.3.2)

Between 1954 and 1966, the once freshwater Mentor Marsh was severely impaired by runoff from salt wells and salt mine tailings. Between 1954 and 1959, salt brine from salt wells on Blackbrook Creek flowed into the marsh and caused die-back of swamp forest between the mouth of Blackbrook and Corduroy Road. In 1966, thousands of tons of low- grade salt ore were dumped over a five-acre area near Routes 44 and 283. In the 20 years after the first salt entered the marsh, sodium ions spread throughout the marsh, significantly changing the ecology of the preserve. The system changed from a freshwater swamp forest to a marsh dominated by salt-tolerant species such as the common reed, *Phragmites australis*.

Mitigation efforts were undertaken in the early 1980s, but it wasn't until nearly 20 years later that we would understand the effectiveness of those efforts. In 1999, an Akron University graduate thesis was completed that assessed the present water conditions of the marsh. The study indicated that chloride levels from salt contaminated runoff from the Osborne Salt Fill have decreased significantly.

The general decrease in chloride concentrations from the baseline study in 1988 to those found by Whipple's study shows that the remediation efforts were somewhat successful. Even with significant improvement in surface water conditions, however, the marsh remains drastically altered from its natural state.

A salt pollution study of Mentor Marsh has been conducted by the Ohio State University with financial support from the Lake Erie Protection Fund (LEPF) and the Ohio Coastal Management Program (OCMP) from September 2004 to 2006. The results discussed below are based on the analysis of preliminary data, which are unpublished. The data show a continued pattern of salt pollution of Mentor Marsh. Total chloride results have been consistently above the tolerance limit for a freshwater swamp forest but well below the tolerance limit for the invasive species *Phragmites australis* (Cav.) Steudel.

The spatial patterning of total chloride levels indicate two primary sources of salt pollution to Mentor Marsh: the salt fill placed over Blackbrook immediately upstream from the Mentor Marsh/Blackbrook confluence; and the abandoned brine fields located to the south of State Route 2 within the Mentor Marsh watershed.

The results indicate the salt fill continues to release large amounts of salt pollution to the Marsh basin. Water samples collected immediately downstream from the salt fill consistently show total chloride levels greater than the upper limit for freshwater ecosystems of 500 mg/l. In April 2005, a water sample collected from this location had total chloride of 2,000 mg/l. The EPA limit is 300 mg/l. Of the 36 water samples collected from this location during the 18-month study period, 29 have exceeded the EPA limit. The average total chloride for this location for the study to date is 721 mg/l.

The salt pollution downstream from the abandoned brine fields might be owing to the recent disturbance of salt-laden soils in this area. In September 2004, a water sample collected downstream from the abandoned brine fields had total chloride of 1,600 mg/l. Of the 47 water samples collected at this location during the 18-month study period, 37 have exceeded the EPA limit of 300 mg/l. The average total chloride for this location for the study to date is 591 mg/l.

Results from additional sampling points located within the marsh basin and at both of its outlets indicate that the salt pollution gets distributed throughout Mentor Marsh. Results show all sample locations within the Marsh basin have exceeded 300 mg/l on multiple occasions except for the remnant swamp forest area located in the southwest portion of the preserve. This area has never exceeded 300 mg/l and has an average total chloride for the study period of 172 mg/l, which is the lowest for any location sampled. This area's location away from the main flow of contaminated water provides a refuge for the remaining swamp forest species (Fineran, Unpublished Data).

Additional investigations were performed by the Ohio EPA in June, 2007 on seeps and surface water on the cap of the landfill. The analytical results of these investigations resulted in the issuance of a "Notice of Violation" to the landowners on November 17, 2006. "Salt contaminated groundwater and surface erosion are allowing the release of pollutants into adjacent surface waters at values far in excess of the State Water Quality Criteria for Total Dissolved Solids and pH as established in Rule 3756-1-07 of the Ohio Administrative Code. The releases have caused a documented violation of the Water Quality Criteria in Black Brook, and then impact the Mentor Marsh, a State Nature preserve." (EPA, 2007)

Hazardous Waste Contamination – Low Priority / Urban (5.3.2)

The Diamond Shamrock site began operations in 1912. Over its 65-year history in Painesville Township, the company produced soda ash, caustic soda, coke sodium bicarbonate, cement, chlorine, chlorinated hydrocarbons, sodium dichromate, chromic acid, chlorowax, and other products. A large amount of hazardous and solid wastes were disposed in large "soup ponds" on site. The wastes include acid, calcium chloride, limestone impurities, chrome wastes, solvents, asbestos, and other wastes.

The plant closed in 1977, and one of the waste lakes was capped in 1982. Ohio EPA and US EPA investigations led to placement on the National Priorities List (Superfund). The Superfund designation has since been withdrawn in favor of a cooperative working relationship among local, state, and federal authorities and the potentially responsible parties. Remediation activities are ongoing at the site.

The Uniroyal facility, which is currently closed, manufactured Paraquil, an intermediate chemical for the tire industry. A radioactive waste site is on the company property, with the potential to leak into the Grand River upstream of the drainage ditch connecting Mentor Marsh and the Grand River.

Uniroyal Chemical began operations at the present 130-acre site in 1965. The site produced various types of nitrile rubber products and ceased operations in June 1999. The company signed an administrative order with the Ohio EPA in May 1999 that requires the company to investigate and clean up any chemical contamination. Further information can be found on the internet at www.lrb.usace.army.mil/fusrap/paine.

Finally, several companies continue active chemical production operations on Fairport-Nursery Road. While these facilities are not located within the watershed, leakage at any of these sites threatens the health of the watershed. Further

investigation of these operations is required to better assess the potential threat to the marsh area.

Storm Water Management – Low Priority / Urban (5.3.2), (5.3.3), (5.8.1), (5.8.2), (7.4.1), 7.4.2), 7.5.3) and 7.6.1)

Under intensive pressure from development, the marsh area has been losing beneficial wetlands and riparian areas at a rapid pace. Residential and commercial development removes considerable areas of vegetation from the landscape and increase paved, or impervious areas. Impervious surfaces impede absorption of rainfall through the soils, which acts to recharge the groundwater. Interrupting this natural recharge process, impervious surface area reduces aquifer capacity and limits the natural flow to rivers and streams during dry periods.

Increasing impervious areas impacts the potential quantity and quality of stormwater runoff. Pollutants and toxic substances such as oils and road salts are carried from these impervious surfaces by stormwater and are deposited in surface water bodies and groundwater. These stormwater discharges into coastal waters and tributary streams increase as impervious areas increase throughout the watershed. The Land Use/ Economic Development Issue Characterization addresses the effects of imperviousness in further detail.

Erosion and Sediment Control – Low Priority / Urban (5.3.2), (5.3.3), (5.8.1), and (5.8.2)

Traditionally regarded as an agricultural issue, erosion and sedimentation have been drawing a great deal more attention in urban areas. It has become evident that the agricultural-related issues have been masking growing erosion and sedimentation problems surrounding urban land uses and construction site runoff. The problems of erosion and sedimentation (“E&S”) are caused by alterations to vegetation and soil surfaces within the watershed. Vegetated areas adjacent to water resources, called riparian buffers, are important landscape features that help to maintain and/or improve water quality by preventing erosion and controlling the transport of sediment into adjacent wetlands and water bodies. Buffer zones are particularly valuable for removing pollutants and excess nutrients from surface water runoff and in some cases from the underlying groundwater. Wetlands also provide the same benefits as riparian buffers, as they serve as collectors and natural recyclers for the eroded sediment. Sediments are particles suspended in a body of water that eventually settle out and accumulate on the bottom of the body of water. Sediment pollution causes problems in water quality by reducing light penetration, covering aquatic organisms, bringing insoluble toxic pollutants into the water, and filling waterways. Suspended sediments adversely affect water quality by carrying toxic chemicals, both organic and inorganic, into the water. The sediment particles provide surface area to which some insoluble, toxic compounds adhere. Additionally, pathogens, or disease-causing agents, can be carried in stormwater runoff and may be partially responsible for some of the bacteria contamination in nearshore areas. Further investigation is needed to better understand the degree to which bacteria along beaches and other toxic elements carried by runoff present public health and safety concerns.

Due to the potential for impacts such as property damage and public safety concerns, regulatory agencies and communities are taking urban E&S seriously. In an effort to abate the runoff pollution, the Lake County Board of Commissioners adopted the Lake County Erosion and Sedimentation Control Rules that require reasonable standards of management and conservation practices. This legislation affects the Mentor Marsh only in the township areas. The City of Mentor, which constitutes 70% of the SAMP region, has its own less stringent E&S rules, (City of Mentor Subdivision Regulations, Section 152.057).

Home Sewage Treatment Systems (HSTS) – Low Priority / Urban (5.6.2)

The density of HSTS in the watershed is <1 per 20 acres and is therefore exempt. Household sewage disposal systems are usually present in the unsewered areas of a community. A variety of factors can affect how a home sewage disposal system will function. Those factors include, but are not limited to, soil types, water tables, depth to bedrock, slope and the amount of water used in the home.

Previous and current studies are indicating that systems throughout Ohio have a statistically significant failure rate. In 1997, the Lake County General Health District initiated a two-phase study to determine the effectiveness of the sewage systems being utilized in at-risk soil types. Systems installed from 1988 through 1996 had an overall failure rate of 17%. The failure rate of home septic systems surveyed in 1997 was 35%. Systems installed where homes are 30 to 40 years old have an estimated failure rate of over 50%.

Used to determine the failure rate of home septic systems, this study was primarily for statistical purposes and not for an enforcement program. Traditionally, the Health District issues orders to repair malfunctioning systems based on a complaint basis. There are no routine inspection programs once a system has been approved and installed.

When a household sewage disposal system fails, one of the results can be off-site discharge, which is a nonpoint source of water pollution. This type of nonpoint pollution may affect the water quality in a couple of different ways. One of these ways is by fecal contamination. Fecal matter contains coliforms, a group of bacteria produced and hosted by feces, soil, water, vegetation and other matter. If present in water, a dangerous water quality problem arises.

Another effect of off-site septic discharge is lack of clarity due to suspended solids when the suspended solids begin to settle in the water. After settling, a sludge layer can form and cause oxygen demand problems. Septic waste in the watershed can create high biological oxygen demand, which robs the water of dissolved oxygen. When dissolved oxygen levels are low, anaerobic (without oxygen) microorganisms produce compounds that have very unpleasant odors, further deteriorating water quality.

The Lake County Health District is currently pursuing new alternatives to traditional household sewage disposal methods. The alternatives include drip irrigation technology and variations of mound systems.

Impoundments and Dams / Hydromodification (7.4.1)

This section was not specifically identified during the development of the SAMP. However, it is a required Management Measure of the Ohio Coastal Nonpoint Pollution Control Program. No impoundments or dams, with the express purpose of creating a reservoir have been located within the watershed. Several man-made features as well as beaver dams in the marsh have acted as hydrologic controls in the watershed. These features are well documented in the Fineran dissertation “Assessing Spatial and Temporal Vegetative Dynamics at Mentor Marsh, 1796 to 2000 A.D.”:

Beaver dams

Beaver dams are cited as a reoccurring problem in the Shipman Pond area. The dams obstruct flow at the mouth of Shipman Pond and raise water levels in the eastern basin. Damming of the mouth of Shipman Pond increases retention time (flood duration) within the marsh basin thereby increasing flood stress. The newspaper article (Headlands Beach Archives: Unknown, August 1, 1974) also mentions the damage done to the trees within the marsh because of the increased flood stress. Currently, beaver continue to build dams across the mouth of Shipman Pond elevating water levels in the eastern basin. State Park rangers periodically clear the dams but beavers quickly rebuild them sometimes in a single night. Water levels in the marsh have been observed to fall nearly 3 feet immediately following the removal of the beaver dams.

Greater Mentor Wastewater Treatment Plant

In 1964, the Greater Mentor Wastewater Treatment Plant (WWTP) was built on the southwest bank of Mentor Marsh. Concurrent with its construction, an embankment was built within the marsh basin to support a large 42-inch corrugated metal outfall pipe with a 36-inch polyethylene liner, which carries treated effluent to Lake Erie. The embankment begins on the southwest bank of the marsh and ends just south of the drainage ditch which flows from east to west within the marsh basin. The embankment carries the WWTP’s discharge (effluent) pipe above ground to the embankment’s end and then the pipe runs underground to its outfall, which is below water level within Lake Erie and is located to the northeast of the mouth of Mentor Harbor. Therefore, the WWTP does not discharge its treated effluent into the marsh basin. The embankment and discharge pipe are still used today and many trees have grown along the embankment. Although the embankment obstructs flow in this portion of the marsh, several breaches in the embankment allow flow to cross at points along its length. Sometime between the treatment facility’s construction in 1964 and 1973, a sanitary sewer line was installed which carries the raw sewage from Mentor Headlands to the wastewater treatment plant. The sewer pipe crosses the marsh from a point on the north bank of the marsh, just west of Wake Robin Trail, to the south bank of the marsh, east of Becker Pond. The sewer pipe is half buried in the marsh with approximately one quarter to one half of the top of the pipe sticking up above the marsh surface. The sewer pipe is made of corrugated metal and is 36 inches in diameter. It appears to be a minor obstruction to surface flow within the marsh basin.

Roads and trails

Corduroy Road was originally built in 1854. As discussed in Chapter 2, a bridge appears to have been built over a stream flowing within the marsh at the time of Corduroy Road's construction. This bridge may have been in existence as late as 1925. There is mention of Corduroy Road being paved in 1927. Perhaps at this time the bridge was replaced with the three culverts that channel flow beneath the roadway today. Corduroy Road acts as a hydrologic obstruction to flow across the marsh basin. The magnitude of its affect on flood duration to the east of the roadway is uncertain. Wake Robin Trail is a boardwalk that extends across the west central basin from the north side of the marsh terminating before it joins with the south bank near the Blackbrook Golf Course. The boardwalk also acts as a hydrologic obstruction to flow within the marsh basin. Several channels have formed beneath the boardwalk with high velocity of flow observed during times of high water. Again, the magnitude of its effect on the flood duration east of the boardwalk is also uncertain.

Land Use and Economic Development

The Marsh Area SAMP region is largely developed, dominated by residential land use. Current land use practices threaten the long-term viability of exceptional natural resources within the region. Existing development patterns compromise ecosystems, and projected future growth and development threaten to further fragment and divide remaining resources. A diversity of landowners and a complicated mix of stakeholder interests and attitudes contribute to land use problems.

The Land Use/ Economic Development Task Force is working to address these and related issues in order to facilitate the development of local land use plans and development controls as a means of safeguarding coastal natural resources and resource usage while preserving and promoting economic development in the SAMP region.

Projected Growth – Low Priority / Urban (5.3.3)

Areas under considerable future development pressure include sensitive areas that are critical to the health of the region's natural resources. Currently, undeveloped, sensitive property near the marsh is not anticipated to be developed in the near future. However, undeveloped areas near the Blackbrook and Marsh creeks may be developed in the next 5-10 years.

The Marsh Creek watershed currently has the most residential, commercial, and industrial development. The major areas of development in the City of Mentor, within the watershed, are the Diamond Center at SR2 and Heisley Road, the Tyler Blvd. extension from Hopkins Road to Heisley Road, and various areas along Mentor Ave. (U.S.20.) The Diamond Center and Mentor Avenue areas are predominantly commercial and office and will continue to develop in this manner for the next five to fifteen years. The Tyler Blvd. area and the Heisley Road area will continue to develop with industrial and office, with limited commercial use interspersed throughout the area on a conditional use permit basis. These commercial uses are complementary to or accessory to the industrial use permitted. This development is likely to occur over the next ten to fifteen years. The vacant parcels along Mentor Avenue will also continue to develop over the next five to ten years.

Concord and Painesville Townships, in the Marsh Creek watershed, have been almost completely developed. The existing uses and zoning are residential and commercial, which are approaching built-out capacity. Residential development has slowed to about one to two houses every three to four years. Commercial development is more active but will be built out within five to ten years. Redevelopment activity is already occurring in the area.

The Blackbrook Creek watershed is the smaller of the two watersheds in the SAMP region that drains into the marsh. Most of the development in this watershed will occur within Painesville City and Painesville Township. Painesville City recently annexed 480-acres from Painesville Township. Single-family housing has been proposed for the area south of CSX Railroad and industrial development to the north. Development of this area is dependent on obtaining access and will likely occur over a twenty- year period or more.

Several factors affect this development trend. These factors are access, wetlands, possible existence of hazardous waste on site, soil conditions, brine wells, and drainage. The balance of the watershed, zoned for light industrial with some areas of residential and two small areas of commercial, will develop slowly for the next five years and depend on Mentor reaching its saturation point. Industrial uses are anticipated to grow more quickly than residential and commercial land uses. Development of this area will probably take 10 to 25 years.

Uncoordinated Land Use Planning – High Priority / Urban (5.3.3)

Continued consumption of the SAMP region's open space and natural resources for the purpose of residential development is the net result of the cumulative consequences of independent local land use decisions throughout the region.

Though the intent of land use planning is to empower local governments to meet the needs of their communities, the result has been fragmentation among the local jurisdictions and little coordination given to regional needs or consequences. Communities do not have a unified vision regarding the desired state for ownership, natural resource management, quality, or levels of use for the marsh and coastal areas.

A total of eight jurisdictions are included in the SAMP area: Mentor, Mentor-on-the-Lake, Painesville, Painesville Township, Concord Township, Grand River Village, Fairport Harbor, and Lake County.

Past difficulties in devising resource management policies for the Mentor Marsh and shoreline as areas of particular concern have resulted, in part, from the breadth of perspectives represented by the diversity of landowners.

Given the diversity of owner interests and available planning tools, local policies must be devised to take into account unique ownership perspectives and natural resource management issues of the individuals and the whole management area. "Common Groundwork: A Practical Guide to Protecting Rural and Urban Land" (Institute for Environmental Education, 1993) is a handbook for making land-use decisions that will provide a wealth of options for the MARC during the Strategy Development Phase of the planning process. This handbook contains a host of privately and publicly initiated tools, such as zoning ordinances, subdivision regulations, and land trusts to consider for use in the SAMP.

Development Pressures – Low Priority / Urban (5.3.3)

Development, particularly residential, is booming in the Marsh Area SAMP region. The development rate for the SAMP region is approximately 205 to 225-acres per year, with an average of 42 lots per subdivision. Generally, this rapid residential growth stimulates positive economic change for the region's communities in the short term. This growth can improve the quality of life for community residents in the short run through an increased tax base and the provision of services that follow; however, in the long term it expands the demand for services beyond the increase in tax base.

In addition to the economic burden of providing services to support residential growth, one of the many negative environmental impacts is wildlife habitat loss due to construction and development. Loss of habitat can destroy the ecotourism component in the marsh area. The economic benefits of visitors to the SAMP region's beaches, natural areas and preserves are highly significant to the region's economy.

Another negative impact development can have on a community's economy is the property damage created by flooding and erosion. When development occurs, the amount of impervious surfaces increases. Impervious surfaces are paved surfaces, such as roads, driveways, and parking lots. These impervious surfaces prevent rainwater from percolating into the ground, thus decreasing the area's natural flood and erosion control capacities. Development occurring on floodplains and stream bank slopes disturbs anchoring vegetation and, consequently, causes the sediment to erode. Floodplains, wetlands, and riparian areas, or lands adjacent to streams or rivers, absorb rainfall and snowmelt. Building on or near these critical areas prevents their ability to minimize the force of runoff, thereby increasing the erosion of stream banks and slopes.

Another related consequence to increasing impervious surfaces is flooding. The increased flow rate and quantity of rainwater or stormwater due to the lack of vegetation on eroded stream banks can present expensive and dangerous flooding problems to landowners along the water. Homes and roads, bridges, and other infrastructure are threatened from increased flooding and erosion.

Wetlands and Biodiversity

Wetlands are of particular importance in the Marsh Area SAMP region. In addition to the biological and environmental quality values wetlands provide, there are numerous associated socio-economic values, such as flood control functions, erosion protection, pollutant filtration, and aesthetics. Wetlands promote biodiversity, defined as an ecosystem's inclusion of a variety and quantity of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur.

The Mentor Marsh State Nature Preserve, City-owned Mentor Lagoons Nature Preserve and Marina, Headlands Dunes State Nature Preserve, and Headlands Dunes State Park have been designated for varying degrees of use while abiding by the principles of natural area preservation. In spite of local, state, and national esteem, these biological gems are threatened. Residential, commercial, and industrial development encroaching on the edge of environmentally sensitive sites continually threatens environmental quality and the long-term viability of the ecosystems. This development, its accompanying hydromodification, and the salt contamination from past years have changed natural landscapes, altered drainage patterns, fragmented inland wetland habitat, stressed littoral ecosystems, and reduced biodiversity throughout associated unique biotic communities.

It is vital that the public understand the current and potential residential and industrial impacts to the environmental quality of natural regional assets, as well as the role of the Marsh Area SAMP's environmental planning initiatives for protecting the rich natural resources of the region.

Biodiversity Loss – High Priority / Urban (5.3.3)

Almost immediately following the brine leakage from salt wells into Black Brook Creek, which flows into Mentor Marsh, the maple-ash-elm swamp forest began to die. Whipple's thesis determined the long-term historical impact of the salt contamination on marsh vegetation by comparing aerial photographs taken over the years between 1937 and 1991. The maps reveal how the salt contamination changed a rich swamp forest community to one dominated by common reed, which occupied 75% of the marsh by 1991. With the die-off of the swamp forest and loss of other native plant communities, a niche was created for common reed and cattail to flourish.

In an ongoing monitoring program, the Cleveland Museum of Natural History has found a remnant of the original swamp forest that is regenerating and shading out some of the common reed. Some examples of efforts to preserve biodiversity include Headlands Dunes State Nature Preserve and vernal pool creation adjacent to Mentor Marsh.

Home to the sea rocket, beach pea, seaside spurge beach grass, and purple sand grass, the 24-acre Headlands Dunes State Nature Preserve is legally preserved as a lakeshore beach dune community through its designation as a Coastal Barrier Resource Area. The preserve is proposed for critical habitat designation for the endangered piping plover, a shore-nesting bird native to the Great Lakes. Piping plovers use wide, flat, open, sandy beaches with very little grass or other vegetation. Nesting territories often include small creeks or wetlands. Many of the coastal beaches traditionally used by piping plovers for nesting have been lost to commercial, residential, and recreational developments.

The Cleveland Museum of Natural History with the approval of the U.S. Army Corps of Engineers, ODNR, Division of Natural Areas and Preserves and the Mentor Marsh Board of Management has recently created 2-acres of vernal pool wetlands in forested uplands to provide habitat for salamanders, frogs, turtles and wood ducks. This vernal pool and hummock habitat was originally lost when the area was settled and the land cleared and leveled for agriculture. Vernal pools are smaller, typically isolated wetlands ecosystems that periodically dry out during late summer. The regular drying of these wetlands prevents the permanent establishment of fish. Vernal pools are often home to sensitive species of invertebrates (i.e. fairy shrimp) or amphibians (i.e. mole salamanders) that cannot tolerate fish predation. Biodiversity is further threatened due to increased development pressures in the watershed. Despite the measurable environmental, social, and economic benefits of wetlands, more than 50% of the wetlands in the continental United States and over 90% of Ohio's wetlands have been destroyed as a result of conversion to agriculture, mining, forestry, and urban uses during the past 200 years. Development threatens the entire marsh area, including Mentor Marsh State Nature Preserve, Headlands Dunes State Nature Preserve, Mentor Lagoons Nature Preserve and Marina, and Headlands Dunes State Park.

Areas targeted for development are often sites overlooking, abutting, or in close proximity to these areas. Mentor, Mentor-on-the-Lake, the villages of Fairport Harbor and Grand River, and Painesville Township are located on the shores of Lake Erie in the center of

Lake County, Ohio. The region is generally urban with homes, industry, and commercial development immediately adjacent to significant wetlands in the SAMP area.

Development pressures in these areas are intense. Between 1995 and 1999, over 1,700 family units have been built within the nearby communities of Mentor, Painesville, Painesville Township and Mentor-on-the-Lake. In the recent past, new homes were constructed directly abutting the Mentor Marsh without any buffer requirements. Development occurring too close to the wetlands has the potential to directly reduce the amount and quality of wetlands required by flora and fauna that depend on this habitat. For instance, homeowners deposit grass clippings and other yard wastes into the preserve, and urban runoff from chemicals applied to new lawns may go directly into the preserve.

Additionally, large developments within the City of Painesville in the Blackbrook Watershed will impair the marsh area with increased stormwater runoff from new roads and other impervious surfaces. Increased pollutant loads from new development are likely, if proper controls are not applied.

Hydromodification – High Priority / Hydromodification (7.4.1), (7.4.2), (7.5.3), and (7.6.1)

Hydromodification has yet to be well studied in the watershed, and consequently, the effects of changes to the hydrology over time are not totally understood. Currently students of The Ohio State University are conducting hydrology research in the marsh. This information should help land managers and planners make more informed decisions on future marsh area development. However, continued long-term hydromodification, in conjunction with rapid growth and development, can lead to the isolation of critical habitats and species from larger ecosystem functions. Ultimately, these activities further contribute to continued losses in marsh area biodiversity.

Compounding these impacts, mitigation for these losses has historically been implemented outside the marsh watershed, further impairing the ecological function of the remaining freshwater wetlands. Specifically, alteration of wetland hydrology or sediment budgets, increased surface runoff through ditching, and wetland conversion to developable lots are some of the examples where small alterations in the natural landscape can result in a cumulative impairment of the wetland's ecological functions.

In addition to direct losses in habitat caused by residential and industrial development, hydromodification resulting from development increases stormwater runoff. Stormwater controls increasingly replace natural riparian areas. As the amount of impervious surface increases with development, stormwater runs into adjacent water bodies, degrading adjacent wetlands and other natural habitats by increasing sediment, nutrient and contaminant loads. Hydromodification reduces the beneficial protection that wetlands provide (flood and erosion control and groundwater recharge). These problems are most apparent near areas of dense residential and industrial development. Federal Phase II Stormwater Management regulations must be considered in upcoming SAMP strategy development.

Natural Disturbances – High Priority / Urban (5.3.2)

Other disturbances include natural and man induced actions. The activities of beavers and other animals may naturally alter the marsh area and retard the restoration of the native swamp forest in the marsh area.

In 1973, beavers moved into the marsh, raising water levels and flooding the northeastern part of the preserve. Today, the presence of beavers, although ecologically important, continues to threaten the regrowth of a swamp forest and may require management.

Fire is both a natural and a human-caused disturbance. Natural fires may keep small areas open. On May 9, 1982, approximately 100-150-acres of marsh burned in the eastern part of the preserve. Another fire took approximately 350-acres on May 11, 1992 in what was known as the “Mother’s Day Fire,” and approximately 60-90-acres of the preserve burned between August 1 and 13, 1998.

Public Understanding and Attitudes – High Priority / Urban (5.3.2)

The general public often does not recognize the value and functions of natural resources. The flood protection of wetlands is not appreciated until the wetlands are lost and residential flooding occurs in areas not previously flooded. Even then, residents often do not have a clear understanding of the connection of flooding to wetland losses.

The erosion protection afforded by natural beaches is not understood until the beach is lost to development and homes are threatened by Lake Erie storms. A lack of understanding of the natural systems that support our economy and quality of life can lead to inadvertent actions that reduce or eliminate the functions and values of the marsh area’s resources.

Creating public awareness of the value and functions provided by natural resources can help instill a sense of stewardship for the marsh area. Both landowners and key decision makers have a responsibility to protect, conserve and develop the marsh area in a sustainable manner. Individual actions can and do play a large role in the preservation and conservation of our natural ecosystems.

Outreach and education efforts are needed to increase awareness of and an appreciation for the natural resources of the marsh area. Such efforts can instill the environmental ethic that will lead to actions needed to restore biodiversity and reduce harmful impacts on the ecosystem.

Recreation and Public Access

For purposes of the Marsh Area SAMP, “recreation” refers to the breadth of experiences visitors enjoy at recreational facilities and via public access areas along the coast of Lake Erie, specifically within the Marsh Area SAMP region. Recreational opportunities and the assurance of public access to sites throughout the marsh area and along the Lake Erie coast provide for social, personal, economic, and environmental benefits. With rapid development of areas around recreational facilities within the SAMP region, many critical public access points could be in jeopardy.

A coordinated regional strategic recreational plan is needed to assess, connect and expand the current recreational and public access uses in the region. This brief discussion summarizes the current recreational conditions and public accessibility and serves as a basis for focusing planning efforts.

Lack of a Strategic Recreation Plan – High Priority / Urban (5.3.2)

Outdoor recreation is a significant economic activity in the Marsh Area SAMP region. A cooperative, coordinated approach to recreation resource management is needed to maintain the diversity and extent of exceptional active and passive recreational opportunities within the region. Currently, the area does not have a strategic plan to guide efforts to preserve and protect recreational and public access resources.

Although programs are effective within each entity's recreation department, potential exists to expand sustainable, low-impact recreational uses within the project area. A strategic regional recreation plan would help to focus efforts designed to maximize recreational resources within the marsh area SAMP region. These efforts could include:

- promoting a deeper understanding among public officials of the tools available for recreational land preservation and acquisition;
- updating the inventory of publicly and privately owned recreational properties and the identification of undeveloped land suitable for future recreation use;
- integrating recreational and public access points into local and regional planning initiatives;
- recommendations for accommodating heavy demand for public lakefront access for a variety of activities;
- guidance to communities on targeted planning initiatives for long-term promotion of recreation and public access resources.

The marsh area encompasses a unique natural area of over 32,200-acres in a fast growing metropolitan area. With over 215,000 residents and the smallest county in terms of area, Lake County is ranked 12th in Ohio's 88 counties for population and continues to grow dramatically. This growth results in increased demands for public access, recreational opportunities, and a disappearance of open space. Since 1977, approximately 24% of open space has been lost in the area.

According to the last Statewide Outdoor Recreation Plan in 1993, Lake County ranked 37 of 88 counties on a per capita basis of land and water-related outdoor recreation acreage. Lake County has a much lower ratio of outdoor recreation to resident than the state. Approximately 67-acres of outdoor recreation per 1000 residents exist in Lake County, while there are 131-acres of outdoor recreation per 1000 residents in Ohio. Approximately 30% of the SAMP region is devoted to open space.

Demand for public access to Lake Erie is significant. Only 40 of the state's 262 miles of shoreline are publicly- owned, a figure that includes ports, military installations and water treatment plants. ODNR's Coastal Management Program reports sixteen miles are local, county or state parks. Twenty-four publicly owned beaches account for approximately

eight miles in shoreline length. The SAMP region includes approximately 2.5 miles of public beach, or 37% of the available Lake Erie public beaches.

When surveyed, Ohioans ranked public nature areas, public fishing areas, public boating and access areas as their greatest outdoor recreation needs. These needs have produced increased number of recreational visits at local, county, and state facilities within the SAMP region. According to the Ohio State Parks 1999 Annual Report, Mentor Headlands State Park, with its coastal beach, provided shoreline enjoyment to 783,324 persons during the summer of 1999. The Mentor Marsh State Nature Preserve saw over 600,000 visitors in 1999 and 3,800 participants in outdoor education activities sponsored by the Mentor Marsh House. Fairport Harbor Lakefront Park, operated by Lake Metro Parks, saw approximately 232,000 visitors in 1999. The total number of 1999 visitors to the SAMP region's parks is estimated to be over 1.5 million persons.

Boating is an extremely popular pastime in Ohio, with over 407,688 registered boats. Of the approximately 9,225 boats registered in Lake County, survey results indicate that over 80% of the users boat on Lake Erie. Ohio Sea Grant conducted a Lake Erie Quality Index Survey, which noted the lack of available dockage and launching facilities along the eastern part of the Lake Erie shoreline from Cleveland to Conneaut as areas of highest concern. The demand for dockage in the watershed is evidenced by the increase in dockers at the Mentor Lagoons Marina from 305 in 1997 to 424 in 2000.

The Fairport Port Authority operates a public boat launch ramp at the mouth of the Grand River. This ramp is only one of eight major boat ramps from Rocky River to the Pennsylvania border. Ramp usage is in the middle range for shoreline ramp usage averaging 12 trailers per weekday and 42 trailers on weekends. The ODNR Division of Wildlife reports that seasonal peak usage can be some of the highest in the state. It is estimated that anglers spend 220,000 hours fishing within a 16-mile wide area adjacent to the SAMP region.

Recreation, public access, and open space within the Marsh Area SAMP region provide significant economic benefits. A National League of Cities Survey of 483 communities found that city leaders rank tourism as one of the top three sectors of their local economy. "Various types of attractions are seen as having particular value for enriching a city's quality of life, attracting visitors, or enhancing economic vitality. Performing arts centers and nature reserves were seen as the top assets for quality of life, along with entertainment and restaurant districts,"

According to the Trust for Public Land (TPL), "Across the nation, parks, scenic lands, wildlife habitat and recreational open space help support a \$502 billion tourism industry. Travel and tourism is the nation's third largest retail sales industry, and tourism is one of the country's largest employers supporting some 7 million jobs," The truth that tourist activity contributes to the health of local economies is certainly true in the SAMP region.

The Mentor Marsh State Nature Preserve and the Mentor Lagoons Preserve annually attract hikers, birders, and nature lovers who purchase goods and services from the local economy. In 1999, the Lake County Visitors Bureau received 12,000 phone inquiries and over 15,000 web site hits regarding tourist activities.

TPL asserts the following in "The Economic Benefits of Parks and Open Space- How Land Conservation Helps Communities Grow Smart and Protect the Bottom Line":

- Protecting open space helps communities grow smart, avoiding higher service costs;
- Open space is a key resource that attracts new residents and business;
- Recreation on public land is a \$40 billion economic activity; and
- Natural Areas and parks attract residents, tourists, and business while boosting the value of nearby properties.

Results of a 2000 survey of Ohio residents, conducted by the Ohio Department of Natural Resources, states that an average of \$70 is spent per visitor to state parks. In 2000, over a million persons visited Headlands State Park, Mentor Marsh State Nature Preserve, Lake Metro Parks' Fairport Harbor Beach, and the Mentor Lagoons Nature Preserve and Marina. Based on the spending per state park visitor of \$70, visitors to the SAMP region contributed approximately \$70 million to the local economy.

Both public and private marinas and public and private boat launch ramps are operated within the SAMP region. The Ohio Sea Grant reports that the economic impact attributable to the marine trades in Ohio is \$233 million and employs 5,121 full time equivalent jobs. On average a boat in Lake County will make 19.4 trips to Lake Erie annually and spend \$203 per trip on fuel, food, and services. It is estimated that there are approximately 1,500 boats that launch or are docked within the SAMP region. Based upon these estimates, boaters within the region purchase approximately \$6 million of goods and services annually. This enormous benefit can be protected and strengthened through coordinated planning.

Numerous state and local comprehensive planning documents have identified the need to preserve and protect critical natural areas and to provide increased public access:

Lake Erie Protection & Restoration Plan-Priority Recommendations:

- Minimize the conversion of green space and the loss of critical habitat areas, forest, and open spaces;
- Enhance public access to Lake Erie for all Ohioans;
- Protect critical fish spawning areas in Lake Erie and its watershed.

ODNR Coastal Management Strategic Plan:

- More nature preserves, parks open spaces and recreational areas in the coastal region;
- More recreational opportunities;
- Easier access to the shore;
- New hands-on-educational opportunities to learn about the unique nature of Lake Erie's coast-for both school children and adults;
- Preservation of remaining wetlands;
- Economic development that enhances Lake Erie's shore;

- More opportunities for citizens to participate in the preservation of Lake Erie's natural resources.

Mentor Lakefront Preserve—Urban Land Institute Recommendations:

- The highest priority will be the preservation of the spectacular ecosystem of the site;
- Learning, recreating, and celebrating at all levels and for all ages shall be accommodated;
- The development of high quality, efficient, and profitable marina will provide a secure boating environment;
- Access should be available to the lakefront and lagoons for all the people of Mentor.

Lake Erie Lakewide Management Plan (LaMP)

The Lake Erie Lakewide Management Plan (LaMP) concludes the “Availability of natural undisturbed land is the single most important condition affecting the restoration of Lake Erie.” A cooperative coordinated approach to recreation resource management is needed to maintain the diversity and extent of exceptional active and passive recreational opportunities within and surrounding the Marsh Area SAMP region.

Negative Impacts of Public Access – Low Priority / Urban (5.3.3)

The negative impacts of public access include increased potential for litter, pollution, impacts to habitat associated with new trails, boat access structures and/or simply the increased numbers of visitors. Maintenance and monitoring are needed to keep the natural areas in the Marsh Area SAMP region clean and attractive. As efforts are made to create and enhance recreational opportunities within the SAMP region, it will be of utmost importance to protect the area's natural resources and facilities from degradation.

From a natural resource perspective, trails and parking facilities need to be placed and designed in a manner that avoids sensitive areas. From a management perspective, increased recreation can lead to conflicts between users. Hikers, horseback riders, rollerbladers, skateboarders, cross-country skiers and cyclists are all looking for specific trail types and experiences. In addition, uses such as ATVs and mountain biking have largely been excluded from natural areas because of adverse impacts on the environment. These conflicts will need to be addressed through multiple trail systems, signage, user education and other innovative arrangements.

There are also issues of vandalism, littering and over-use that accompany increased recreation use. To a certain extent, these issues are unavoidable. However, certain practices can be instituted to minimize their impact on the attractiveness and health of the SAMP region's natural areas. Timely maintenance and inspection of trails and facilities will help to reduce vandalism and littering. Meanwhile, on-going evaluation of user impacts on the natural resources will guard against over use.

Public Outreach – Low Priority

Unfortunately, communities within the Marsh Area SAMP region have not always benefited from public outreach efforts designed to promote a basic understanding of environmental concepts, including the proper ethical behavior associated with natural environments in recreational areas. Research conducted by the Ohio Statewide Comprehensive Outdoor Recreation Plan suggests that many forms of depreciative behavior (littering, vandalism, polluting, etc.) take place because people don't understand the impacts of their actions on others and the natural environment.

The promotion of learning-based recreation public outreach offers significant opportunity for both visitors and local communities within the region. Environmental education allows the public to better appreciate park and recreational resources while promoting better stewardship of public lands. An environmentally aware public is less likely to misuse public lands and more apt to respect and act more responsibly toward public lands. Environmental education regarding the benefits of preserving and protecting the environmental assets of the Marsh Area SAMP region help to instill a land ethic with strong natural resource based motives. In so doing, enabling individuals and communities to understand and recognize the effects that they have on natural surroundings as well as to encourage the development of personal values that will minimize environmental degradation.

Shoreline Management and Nearshore Issues

Approximately 90% of the sand that makes up Lake Erie's beaches comes from erosion of the lake's bluffs, which are comprised of 15% to 20% sand. The rate of erosion or recession is primarily dependent on the strength of the shore materials and the exposure of the shore to wave action. Other contributing factors include long-term changes in water levels, changes in land use patterns, and alterations to surface and subsurface drainage. Reduction of the sediment supply through the installation of shoreline protection and the trapping of sand updrift of large jetty structures has affected shoreline processes.

Planning initiatives must take into consideration the role of this dynamic shoreline and the influence of its natural processes upon nearshore issues such as coastal erosion and bluff recession rates. Sediment transport, landowner practices, increased surface water runoff, reductions in vegetative cover, and the trapping of sand updrift of large jetty structures impact the shoreline process and nearshore issues. By understanding the major issues affecting the stability of the region's shoreline, the MARC will be better capable of designing policies as part of the Marsh Area SAMP that will most effectively protect and preserve natural resources and coastal economic growth.

Lake County has approximately 30 miles of shoreline fronting Lake Erie. The shoreline is bordered, for the most part, by 30 to 40 -foot till bluffs that are capped in places by glaciolacustrine clay, silt and/or sand. A discontinuous ribbon of sand fronts the shoreline. Where beaches are present, they are typically less than 25 feet wide. The principal exceptions are wider beaches located to the west of major jetty structures, such as Fairport Harbor, Mentor Harbor, and First Energy's Eastlake Power Plant.

Shorelines along the Great Lakes are subject to the natural processes of flooding (including high water levels, wind setup and wave runup), erosion and dynamic beaches. These are natural shoreline processes that only become "hazards" when a development is located too close to the shoreline. Hazards can be defined as natural events that present a danger to life or result in significant property damage.

The long-term, large-scale evolution of the Marsh Area SAMP shoreline is dependent upon the controlling substrate. “Controlling substrate” is defined as the dominant underlying material that makes up the main body of the lakebed in the nearshore and the offshore. Along shorelines where the controlling substrate consists of bedrock (e.g., erodible or erosion resistant) or cohesive material (e.g., cobble/boulder till, fine-grained cohesive), there may also exist unconsolidated, cohesionless sediment (e.g., sand, gravel, shingle, cobbles). The cohesionless sediment may even extend onshore, appearing as a beach deposit. However, the volume of these surficial materials is insufficient or too transient to protect the underlying material from the wave action. Dynamic beach shorelines are composed of such deep sand and gravel deposits that any underlying bedrock or cohesive material is never exposed. Therefore, the dynamic beach material itself can be considered the controlling substrate.

Longshore transport is the movement of beach sediment, parallel to the shoreline, by waves and currents. Because of the southwest-northeast trending shoreline, the prevailing westerly winds, and a fetch as great as 100 miles to the west and up to 60 miles from the north, the net sediment transport is from southwest to northeast.

Shoreline bluffs, subject to wave action at the slope toe, commonly experience cycles of erosion and slope instability leading to crest recession. Erosion may start when lake levels rise and cover previous beach areas along the bluff toe. This allows wave action to undercut and locally over-steepen the slope toe. Similar to gully and river erosion, this toe undercutting triggers the loss of vegetation cover near the slope toe, which progressively spreads up the slope face. This sets in motion a whole series of subaerial processes (e.g., gravity, groundwater) in an effort to restore an equilibrium slope through bluff or bank failure. These subaerial forces usually tend to include slumps, slides, falls, or flows.

Along shorelines where the downcutting process is limited—due to the presence of a rock outcrop, a thick deposit of sand on the nearshore profile, or a rapid decline in water levels—erosion of the shore bluff or low plain will be dominated by subaerial processes. In these situations, the bluff will ultimately establish a stable slope position while the low plain will return to a continuous, gently sloping plain. There may be infrequent episodes of bluff undercutting during periods of extremely high water levels.

Insufficient Sand Supply – Medium Priority

There is insufficient sand supply to provide natural beaches, which reduces the available supply of sand needed for protection of the bluffs. In order for beaches to be established to protect the bluffs from erosion, there must be an adequate supply of sand in the littoral drift system. The majority of the sand comes from the erosion of the shoreline bluffs and the scour of the nearshore bottom materials.

Although erosion is a naturally occurring and continuous process, the short-term impacts of excessive wave action and heightened water levels, particularly during storm events, tend to cause the more readily visible, short-term destruction and shore losses. Evidence of these losses is typically visible in the undermining and collapse of shore bluffs or through the rapid changes in beach profiles.

The primary erosional process affecting the cohesive and erodible bedrock profiles along the open shorelines of the Great Lakes is direct wave action on the subaqueous nearshore profile, resulting in the erosion, or downcutting, of the lakebed material. This ongoing downcutting allows waves to reach the slope toe with more power. Nearshore downcutting is described in greater detail earlier on in this report. In addition, wave uprush and abrasive effects of entrained coarse sediments, which accompany the wave action, cause an additional erosional impact on the subaqueous nearshore profile and toe of a bluff or bluff

face. It is this combination of wave action and accompanying abrasive forces that essentially act to dislodge the shore material, which is then quite often quickly removed by alongshore and offshore currents. The sand released by these processes is normally transported west-to-east along the shoreline. An adequate supply of sand will build beaches sufficiently to reduce the erosive force of the waves to a minimum.

The 1250-foot long intake jetties located at the Eastlake Power Plant just west of the Chagrin River interrupt the west-to-east longshore transport of sand. Since the mid-1980s, sand dredged from the intake channels has been returned to the nearshore zone east of the Chagrin River. As a result, much of the sand transported along the shore between the Chagrin River and Mentor Lagoons is supplied by three possible mechanisms: 1) when the sand dredged from the Chagrin River is discharged in the nearshore zone east of the river; 2) when flood events flush sand from the Chagrin River; or 3) when waves erode the bluff between the Chagrin River and Mentor Lagoons.

Because of the high erosion rates caused partly from disruption of sand transport by the power plant jetties, many landowners have chosen to try to armor their lakefront property with various forms of shore protection. Protecting the shore from erosion aggravates the problem of sand supply, because erosion of the bluff no longer supplies sand to the littoral system. This, in turn, greatly increases erosion in unarmored areas.

Activities Landward of the Bluff Edge – Medium Priority

A major factor in erosion of the bluffs is activity that occurs on the landward side of the bluff. Coastal erosion areas (CEA) occur along 6.9 miles of the reach and affect 331 parcels. Of the approximately 233 lakefront homes in the Marsh Area SAMP region, about 30% sit within 50 feet of the bluff edge, and about 39% are in the 30-year CEA. The development occurring landward of the bluff in the CEA has a negative influence on the long-term health of the SAMP region shoreline.

While the shoreline is a highly desirable site for homes and industry, it is also a highly sensitive environment. A great deal of care needs to be taken in developing this area to prevent aggravating the existing erosion problems. A lack of understanding of shoreline dynamics often leads landowners to develop their property in ways that are detrimental to the land/lake interface. Undeniably, a lake view is desirable, but clearing of the vegetation that obscures the view can drastically increase the erodibility of the bluff.

Building too close to the bluff can also aggravate the mass wasting process by changing stormwater absorption characteristics and adding weight to what is normally an already unstable slope. In addition, development that is too close to the bluff is frequently subject to damage by the erosion. This usually results in attempts by the owners to protect their property. Unfortunately, these protection measures often further aggravate the existing problems.

Some consequences of human activity occurring in the CEA are surface runoff and removal of vegetation. Surface runoff can have a major effect on rill and gully erosion of the bluff face. Excess water from storm drains may also contribute to further damage of the bluff. Removal of vegetation along the bluff face and edge also tends to weaken the bluff by removing reinforcing root structures and the plants that reduce soil moisture through evapotranspiration.